EP 501 Homework #1


```
% EP 501 Homework 1 Main
% Julio Guardado

clear;
clc;
close all;
```

Problem 1.a + 1.b

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%')
disp('Problem 1 Part a+b:')

%load test problem
load testproblem.mat

%used simple elimination function
Amod = forward_elim(A,b);

%test function with built in matlab functions and provided backsub.m
test_ans = A\b;
answer = backsub(Amod);

%display solution
fprintf('\tMATLAB:\t  forward_elim.m:\n')
disp(cat(2,test_ans,answer))
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Problem 1 Part a+b:
    MATLAB:   forward_elim.m:
    1.0000    1.0000
    2.0000    2.0000
    3.0000    3.0000
    4.0000    4.0000
    5.0000    5.0000
    6.0000    6.0000
    7.0000    7.0000
    8.0000    8.0000
```

Problem 1.c

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%')
disp('Problem 1 Part c+d:')

%load test problem
load lowertriang_testproblem.mat

%solve using matlab built in func
test_ans = L\bL;

%solve using forwardsub func
answer = forwardsub_lt(L,bL);

%display solution
%display solution
fprintf('\tMATLAB:\t  forward_sub.lt.m:\n')
disp(cat(2,test_ans,answer))
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Problem 1 Part c+d:
    MATLAB:   forward_sub.lt.m:
    1.0000    1.0000
    3.0000    3.0000
    5.0000    5.0000
    7.0000    7.0000
    9.0000    9.0000
   11.0000   11.0000
   13.0000   13.0000
   15.0000   15.0000
```

Problem 2

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%')
disp('Problem 2:')

%load test problem
load testproblem.mat

%solve using matlab built in func
test_ans = inv(A);

%solve using forwardsub func
[~, invA] = GJ_elim(A,eye(8));

%display solution
disp('Solution from built in MATLAB function:')
disp(test_ans)
disp('Solution from GJ_elim.m:')
disp(invA)
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Problem 2:
Solution from built in MATLAB function:

   -0.4480    0.3835    0.0281   -0.0881   -0.5795    1.0474   -0.5356    0.2581
   -0.0540   -0.1948   -0.2456   -0.6264    0.1978   -0.2692    0.2222    0.2324
    0.2062   -0.1064   -0.3766   -1.1154   -0.0220    0.5605    0.2837    0.3873
   -0.3250    0.4251    0.0724   -0.1670   -0.3128    0.8816    0.4305    0.2608
   -0.0697   -0.5582   -0.4000   -1.3059    0.0704    0.6537    0.8908    0.6467
    0.3565    0.3345    0.1079   -0.1491    0.2014    0.0363   -0.2920   -0.6463
   -0.1222    0.1436    0.0008    0.7677   -0.2421   -0.0132   -0.1231   -0.7433
    0.1043   -0.2818   -0.2839   -0.2878    0.4281   -0.1212    0.1503    0.0735

Solution from GJ_elim.m:

   -0.4480    0.3835    0.0281   -0.0881   -0.5795    1.0474   -0.5356    0.2581
   -0.0540   -0.1948   -0.2456   -0.6264    0.1978   -0.2692    0.2222    0.2324
    0.2062   -0.1064   -0.3766   -1.1154   -0.0220    0.5605    0.2837    0.3873
   -0.3250    0.4251    0.0724   -0.1670   -0.3128    0.8816    0.4305    0.2608
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    0.3565    0.3345    0.1079   -0.1491    0.2014    0.0363   -0.2920   -0.6463
   -0.1222    0.1436    0.0008    0.7677   -0.2421   -0.0132   -0.1231   -0.7433
    0.1043   -0.2818   -0.2839   -0.2878    0.4281   -0.1212    0.1503    0.0735
```

Problem 3.a-c

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%')
disp('Problem 3.a-c:')

%load test problem
load testproblem.mat

%perform Doolittle LU factorization
[L, U,X] = DLU_fact(A,cat(2,b,b2,b3));

%display solution of first b matrix
disp('Solution of test problem from L and U:')
disp(X(:,1))

%display solution of multiple right hand sides
disp('Solution of multiple right hand sides from L and U:')
disp(X)
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Problem 3.a-c:
Solution of test problem from L and U:
    1.0000
    2.0000
    3.0000
    4.0000
    5.0000
    6.0000
    7.0000
    8.0000
```

```
Solution of multiple right hand sides from L and U:
    1.0000    2.0000   10.0000
    2.0000    4.0000   20.0000
    3.0000    6.0000   30.0000
    4.0000    8.0000   40.0000
    5.0000   10.0000   50.0000
    6.0000   12.0000   60.0000
    7.0000   14.0000   70.0000
    8.0000   16.0000   80.0000
```

Problem 3.d

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%')
disp('Problem 3.d:')

%solve using matlab built in func
test_ans = inv(A);

%solve using LU Factorization
[~,~,X] = DLU_fact(A,eye(size(A,1)));

disp('Solution from built in MATLAB function:')
disp(test_ans)
disp('Solution from Doolittle LU factorization:')
disp(X)
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Problem 3.d:
Solution from built in MATLAB function:

   -0.4480    0.3835    0.0281   -0.0881   -0.5795    1.0474   -0.5356    0.2581
   -0.0540   -0.1948   -0.2456   -0.6264    0.1978   -0.2692    0.2222    0.2324
    0.2062   -0.1064   -0.3766   -1.1154   -0.0220    0.5605    0.2837    0.3873
   -0.3250    0.4251    0.0724   -0.1670   -0.3128    0.8816    0.4305    0.2608
   -0.0697   -0.5582   -0.4000   -1.3059    0.0704    0.6537    0.8908    0.6467
    0.3565    0.3345    0.1079   -0.1491    0.2014    0.0363   -0.2920   -0.6463
   -0.1222    0.1436    0.0008    0.7677   -0.2421   -0.0132   -0.1231   -0.7433
    0.1043   -0.2818   -0.2839   -0.2878    0.4281   -0.1212    0.1503    0.0735


Solution from Doolittle LU factorization:

   -0.4480    0.3835    0.0281   -0.0881   -0.5795    1.0474   -0.5356    0.2581
   -0.0540   -0.1948   -0.2456   -0.6264    0.1978   -0.2692    0.2222    0.2324
    0.2062   -0.1064   -0.3766   -1.1154   -0.0220    0.5605    0.2837    0.3873
   -0.3250    0.4251    0.0724   -0.1670   -0.3128    0.8816    0.4305    0.2608
   -0.0697   -0.5582   -0.4000   -1.3059    0.0704    0.6537    0.8908    0.6467
    0.3565    0.3345    0.1079   -0.1491    0.2014    0.0363   -0.2920   -0.6463
   -0.1222    0.1436    0.0008    0.7677   -0.2421   -0.0132   -0.1231   -0.7433
    0.1043   -0.2818   -0.2839   -0.2878    0.4281   -0.1212    0.1503    0.0735
```

Problem 4

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%')
disp('Problem 4:')

%load test problem
load iterative_testproblem.mat

%set up
nit = size(Ait,1);
x0=randn(nit,1);
tol=1e-9;
omega = 1;

%solve using matlab built in func
test_ans = Ait\bit;

%solve using Successive over relaxation
[xit,nit] = SOR(x0,Ait,bit,tol,omega);

%display solution
fprintf('\tMATLAB:\t  SOR.m:\n')
disp(cat(2,test_ans,xit))
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Problem 4:
    MATLAB:   SOR.m:
    0.0329    0.0329
    0.1316    0.1316
    0.2400    0.2400
    0.3375    0.3375
    0.4142    0.4142
    0.4642    0.4642
    0.4839    0.4839
    0.4720    0.4720
    0.4293    0.4293
    0.3584    0.3584
    0.2641    0.2641
    0.1526    0.1526
    0.0310    0.0310
   -0.0926   -0.0926
   -0.2101   -0.2101
   -0.3138   -0.3138
   -0.3971   -0.3971
   -0.4544   -0.4544
   -0.4819   -0.4819
   -0.4780   -0.4780
   -0.4427   -0.4427
   -0.3785   -0.3785
   -0.2896   -0.2896
   -0.1817   -0.1817
   -0.0619   -0.0619
    0.0619    0.0619
```

```
    0.1817    0.1817
    0.2896    0.2896
    0.3785    0.3785
    0.4427    0.4427
    0.4780    0.4780
    0.4819    0.4819
    0.4544    0.4544
    0.3971    0.3971
    0.3138    0.3138
    0.2101    0.2101
    0.0926    0.0926
   -0.0310   -0.0310
   -0.1526   -0.1526
   -0.2641   -0.2641
   -0.3584   -0.3584
   -0.4293   -0.4293
   -0.4720   -0.4720
   -0.4839   -0.4839
   -0.4642   -0.4642
   -0.4142   -0.4142
   -0.3375   -0.3375
   -0.2400   -0.2400
   -0.1316   -0.1316
   -0.0329   -0.0329
```

Problem 5

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%')
disp('Problem 5:')

%load test problem
load testproblem.mat

%solve using matlab built in func
test_ans = det(A);

%solve using determintant.m
[~,determ] = Gauss_elim_det(A,b);

%display solution
fprintf('Determinant calculated by MATLAB:\t\t\t %f\n',test_ans)
fprintf('Determinant calculated by Gauss_elim_det.m,: %f\n',determ)
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Problem 5:
Determinant calculated by MATLAB: -39.424745
Determinant calculated by Gauss_elim_det.m,: -39.424745
```